

Ongoing Kalina Cycle® Developments

Innovative Energy Systems Workshop

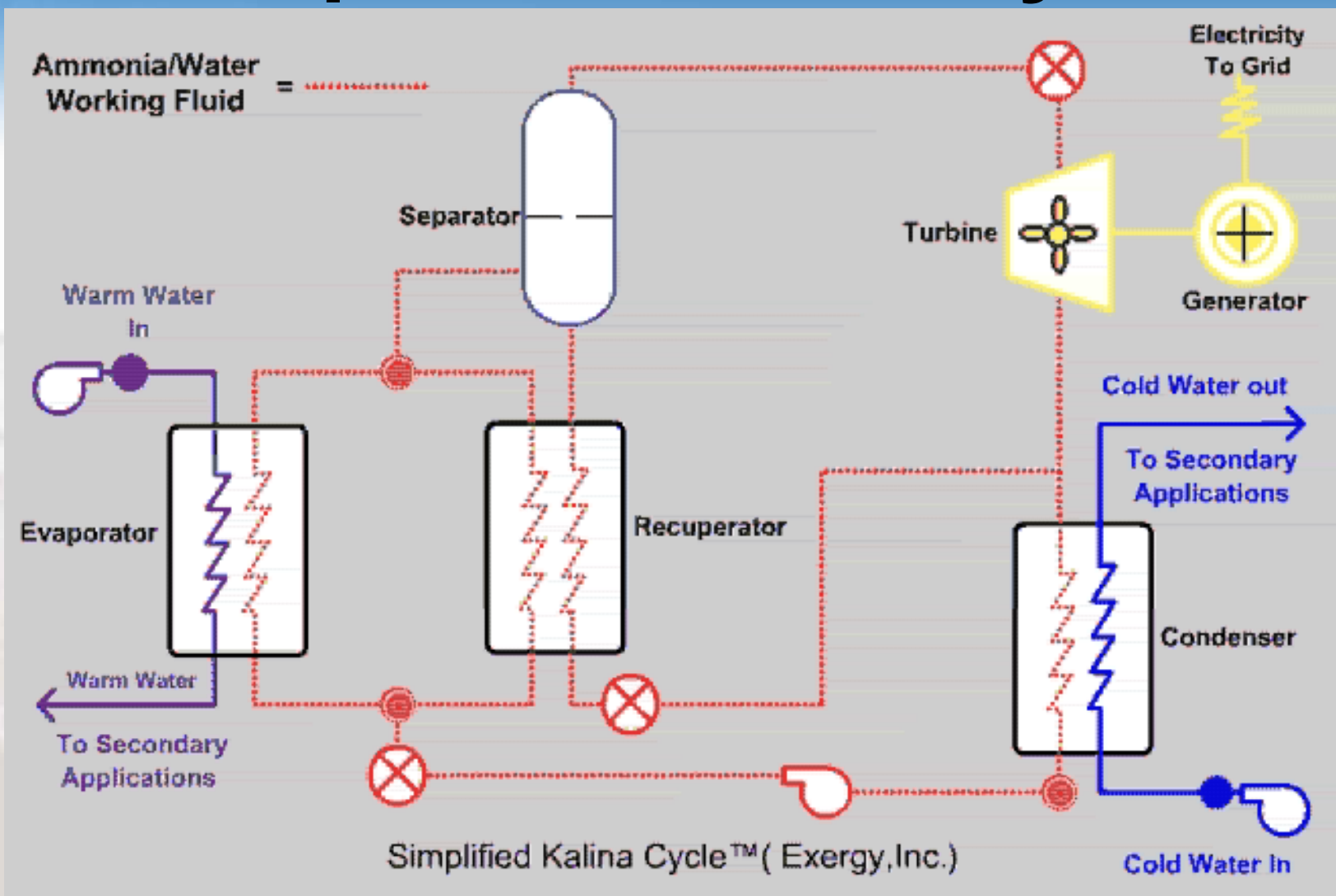
**Honolulu, Hawaii
March 19 – 20, 2003**

Presented by:

**Hans J. Krock, PhD, PE
Professor, University of Hawaii at Manoa**



Simplified Kalina Cycle[®]



**Bottoming Cycle
Installations of the Kalina
Cycle® in Several Locations
Globally Have Excellent
Operational Records**



Operational Kalina Cycle[®] Plants

Courtesy: Exergy

**3.5 MW Kalina Cycle[®] Plant
Canoga Park, CA**



**2 MW Kalina Cycle[®] Plant
Husavik, Iceland**

Courtesy: Exergy



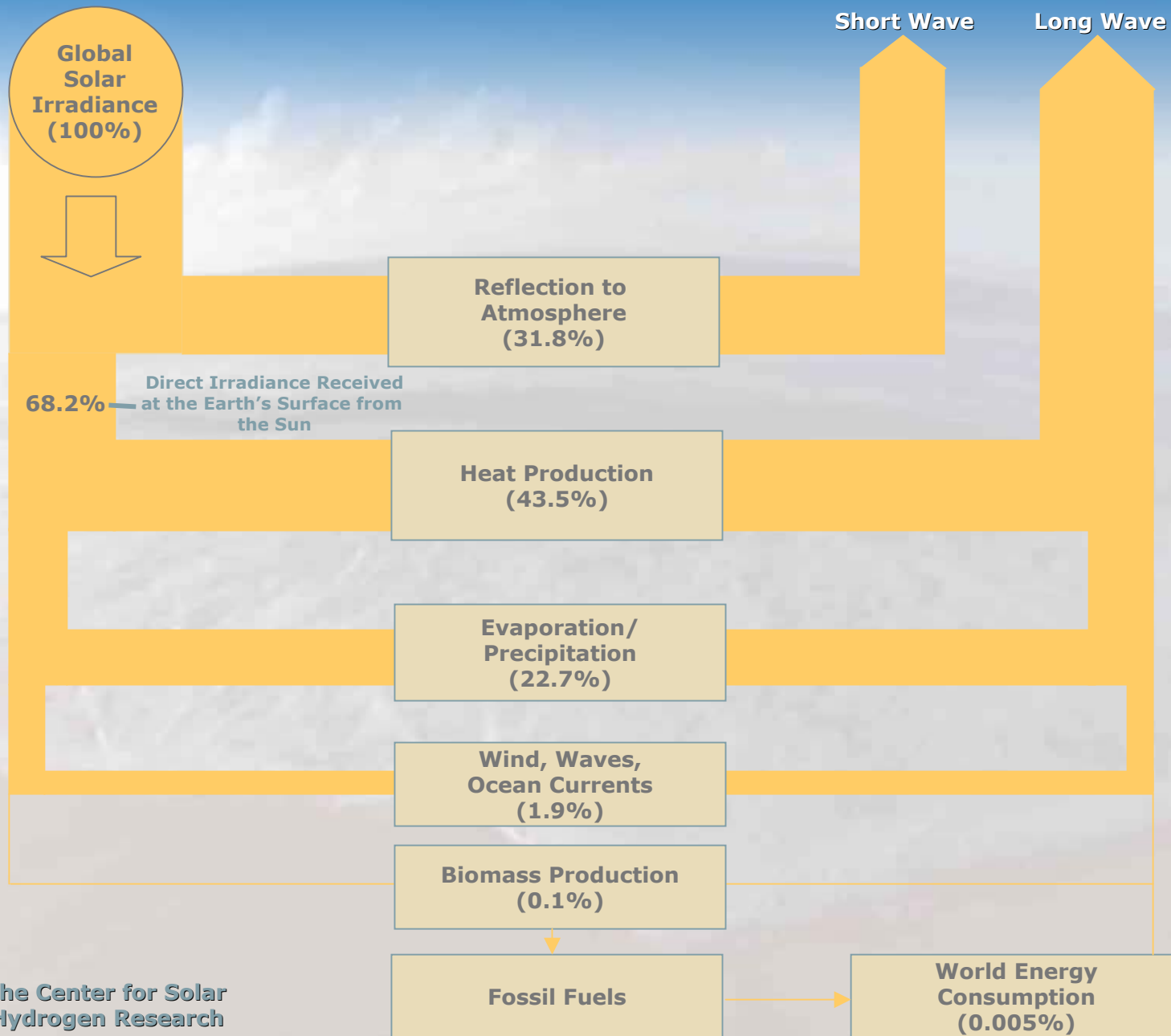
OTEC Systems:

Island Based Multi-Product Optimized Systems.

Power Production by the Kalina Cycle®



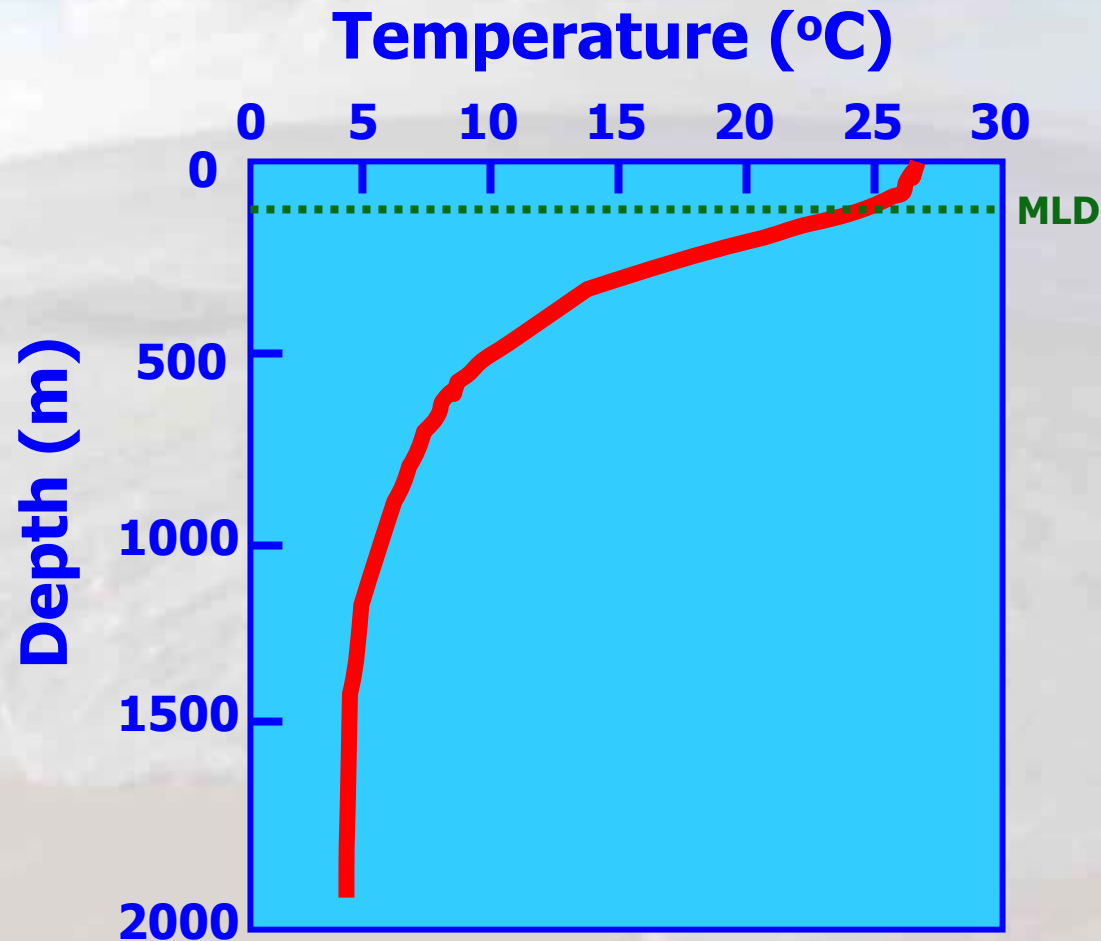
Earth's Solar Energy Flux



Note
Total
terrestrial
irradiance is
roughly
equivalent to the
irradiance
incident upon the
Tropical
Oceans!



Tropical Ocean Temperature Profile

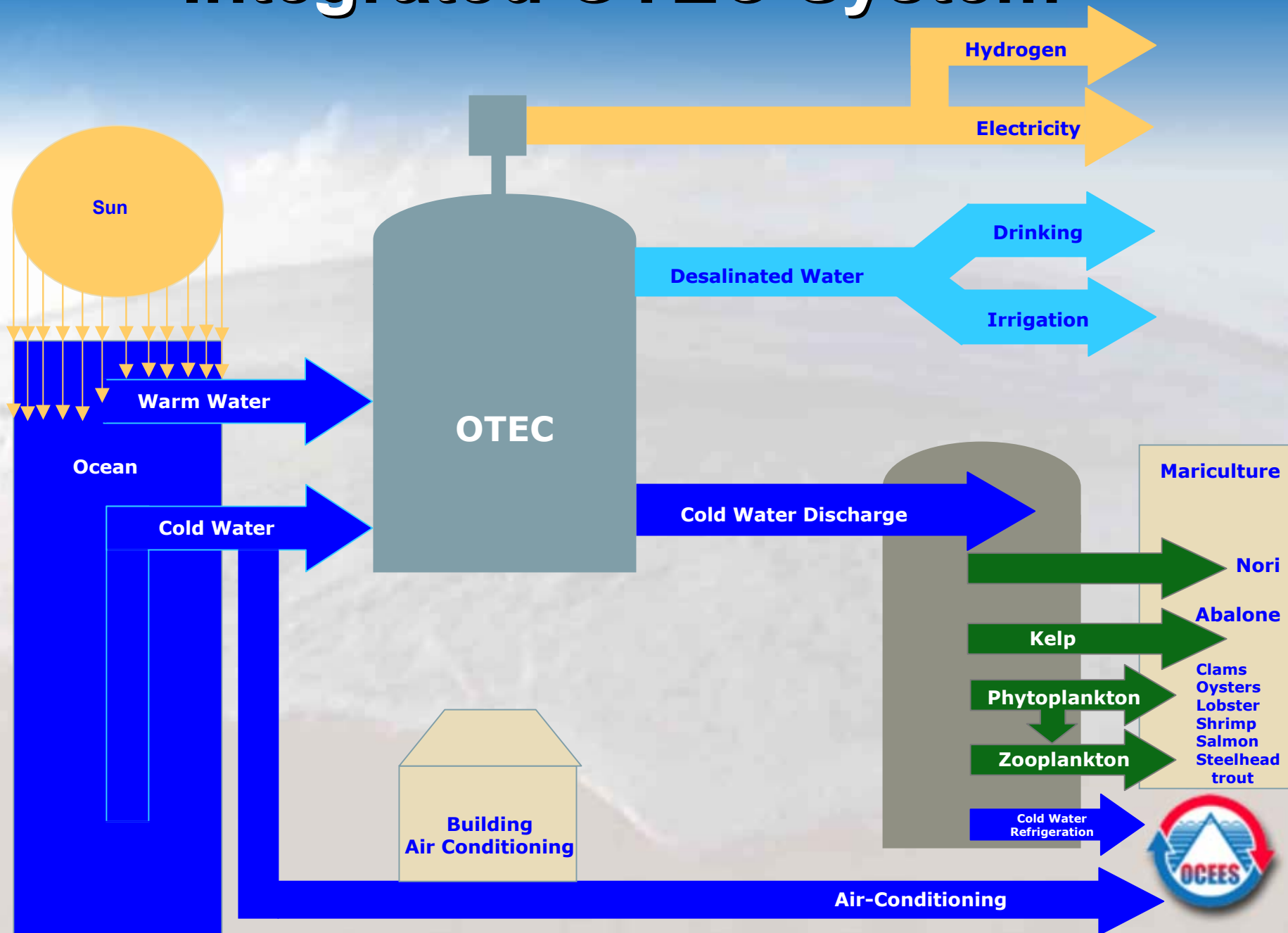


Hawaiian Based Research Advances in OTEC

- **Cold Water Pipe Design and Installation**
- **Closed-Cycle OTEC Net Power Production**
- **Bio-fouling Control in Warm Water System**
- **Closed-Cycle Aluminum Heat Exchanger Dynamics**
- **Non-Condensable Gas Exchange Dynamics**
- **Aquaculture Development**
- **Open-Cycle OTEC Fresh Water Production**



Integrated OTEC System



Parameters Required for Kalina Cycle[®] Design:

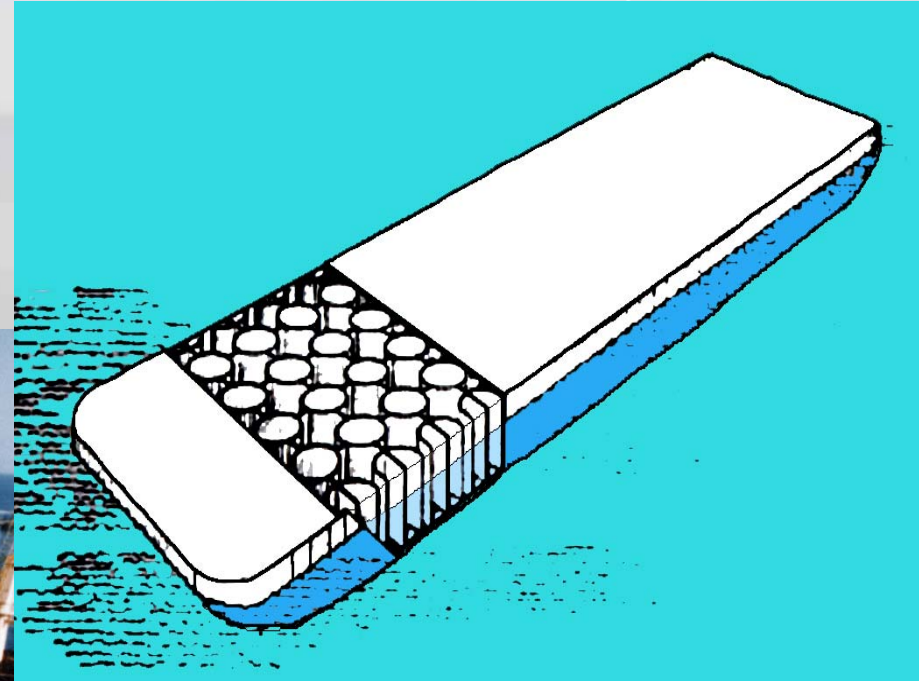
- **Delta T**
- **Flow Rates**
- **Chemical Environment**
- **Elevation**



Shore Based System or Concrete Barge System

Courtesy: Alfred Yee & Associates

Platform Under Construction



OTEC Platform Concept

Courtesy: Alfred Yee & Associates



Technical Developments in the Last Decade

- **Operating Kalina Cycle® Plants**
- **Open-Cycle OTEC Pilot Plant**
- **Non-Condensable Gases Problem Solved**
- **Cold Water AC Installed**
- **Open-Cycle OTEC Turbine Design**
- **Fresh Water Production with Open-Cycle OTEC Systems**
- **Multi-Product Systems Engineering**
- **Oil Drilling Platforms in Depths Greater than 3000 Feet**

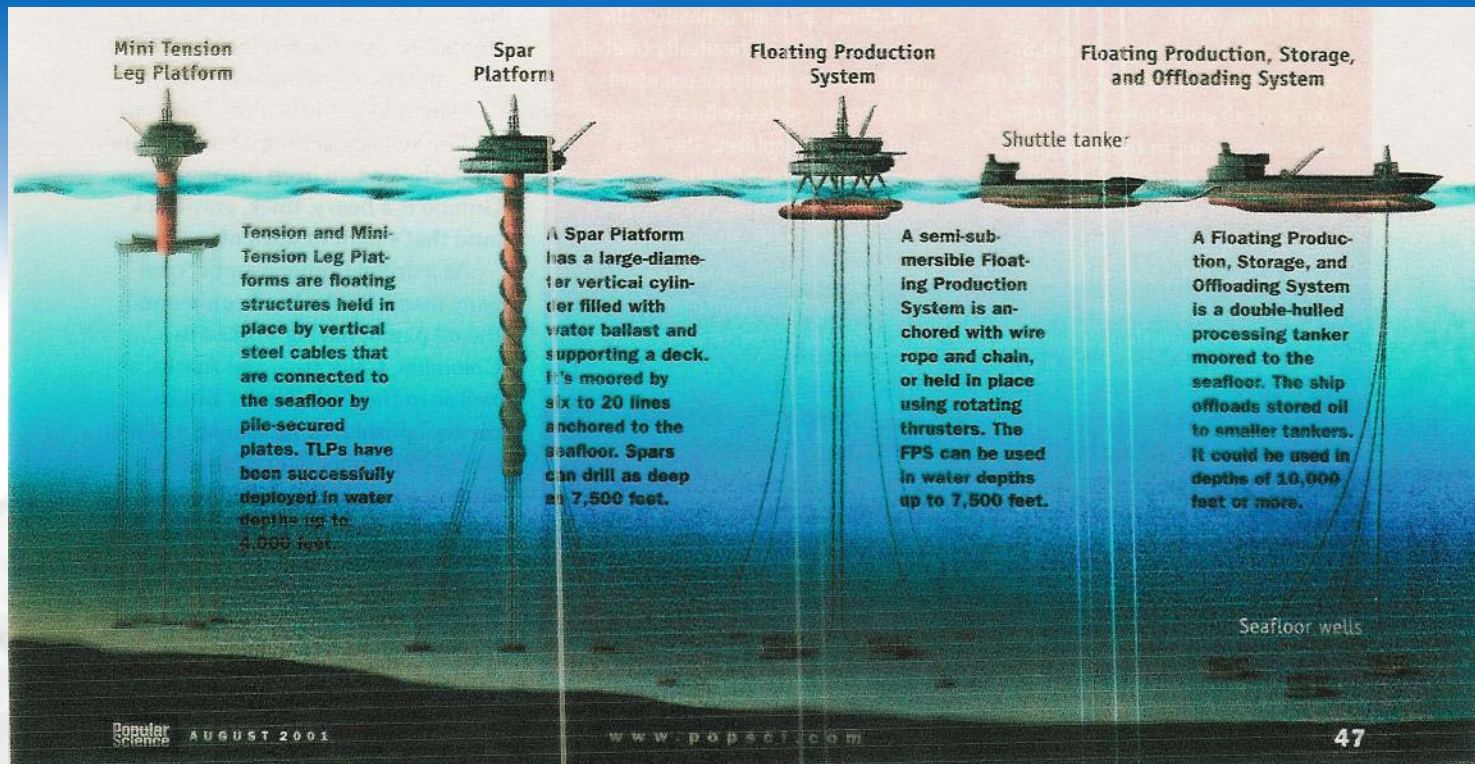


**Economic Conditions
are Presently
Favorable Because of
Low Interest Rates and
High Oil Prices
Especially in Niche
Markets**



Large Scale Floating Systems for Power Production and Hydrogen Production and Liquefaction





Courtesy: Popular Science

Deep Water Offshore Platforms Developed by the Oil Industry are Adaptable for OTEC Application



Natural Synergy for LH₂ Production

- **Constant Production Rates**
- **Pure Water Resource**
- **Heat Sink for Liquefaction**
- **Convenient Transport**



**Economics are
Favorable if
Coordinated with
Offshore Oil Industry**



**Transportation Fuel
Should Be
Economically
Evaluated on a Per Mile
Basis Rather than on
Equivalent Energy**



**The Kalina Cycle® is
Proven Technology
with a Bright Future in
the Development of the
Largest Renewable
Resource in the World
The Tropical Ocean!**

